EXP-14
June 20, 1972

ACCELERATOR EXPERIMENT--Radiation Data and Vertical Misalignment of Bending Magnets

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Date Performed: May 31, 1972

Measurements:

1. The residual radiation was measured with a geiger counter during 6 hours after 6 days of continuous running of the beam up to the energy of 80 GeV. The radiation data are displayed in Figs. 1 and 2. The "hot spots" are indicated with black strips. The radiation level in the remaining locations of the ring is normal.

2. A beam profile monitor was placed just before F17-4 where $\beta_y \sim 55$ m. The vertical size of the beam was ~2.6 cm which corresponds to the vertical emittance of $\sim 3\pi$ mm mrad.

3. Proper steering of the beam was done to keep the low-energy closed orbit centered.

We look for possible correlations between the radiation data and the vertical emittance limitation due to misalignment of the bending magnets. Most of the beam loss occurs at low energy, and we shall assume that the radioactivity is induced mainly by the low-energy beam.

Analysis:

1. Displacement of every magnet and the radiation spots are displayed in Figs. 1 and 2, sector by sector. The magnets can be divided into 15 groups according to the local β value as shown in Table 1. Corresponding to the magnets of the same group we have the same size 2a of the beam and the same clearance 2c available in the case of perfect alignment.

   Values of a and c are listed in Table 1 for the two values of the beam emittance. The maximum allowed displacement for a magnet is, of course, c. The magnets having the tightest limitation to the vertical aperture and their actual displacements are

A48-5	-0.010"	D48-5	-0.005"
B48-5	not surveyed	E48-5	not surveyed
C48-5	+0.030"	F48-5	+0.025"

   These magnets seem to be fairly well aligned.

   The data shown in Figs. 1 and 2 correspond to the last survey made in October 1971.* Since this date, 120 magnets have been changed with no survey.

2. The following is the list of magnets with the smallest local maximum beam emittance that can be allowed.

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*The following magnets have never been surveyed: B48-5, C15-5, D23-4, E35-3, E48-3, E48-5.

Position	Magnet	Displacement	Max. Emittance
D21-4*	1626	+.205"	3.0π mm mrad
B44-3	1069	-.155"	3.5π mm mrad
D38-3*	1151	-.130"	"
B32-3*	1107	-.120"	"
C24-3	1103	-.115"	"
B38-3	1229	-.110"	4.0π mm mrad

Radiation spots are associated with magnets listed above with an asterisk. We notice some correlation, hence, realignment of these magnets is highly desirable. All the other magnets allow an emittance larger than 4.0π mm mrad.

3. The maximum emittance that the main ring can tolerate because of the magnet misalignment seems to be in agreement with the measured emittance. Since the beam is limited by D21-4 the unlimited emittance may well be larger than 3π mm mrad. We should therefore realign vertically all the bending magnets to gain back the full acceptance of 4.75π mm mrad. Of course, even the limited emittance of 3π mm mrad is still larger than the nominal design emittance by almost a factor of 2. We should try to understand the cause of this excessively large emittance.

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Table 1

#	Cell	Magnet	β_y	a_1	a_2	c_1	c_2
			m	mm		inches	
1	C	B1(2)	39.9	7.74	13.78	.384	.146
2	C	B1(3)	54.4	9.03	16.08	.333	.056
3	C	B2(4)	72.9	10.46	18.62	.572	.251
4	C	B2(5)	95.4	11.96	21.29	.513	.146
5	C	B2(2)	88.6	11.53	20.53	.530	.176
6	C	B2(3)	67.3	10.05	17.89	.589	.280
7	C	B1(4)	49.9	8.65	15.40	.348	.083
8	C	B1(5)	36.6	7.41	13.19	.397	.170
9	CL	B1(3)	39.8	7.73	13.76	.385	.147
10	CL	B1(4)	50.5	8.70	15.49	.346	.079
11	CL	B1(5)	64.4	9.83	17.50	.302	-
12	CL	B2(2)	85.2	11.30	20.12	.540	.192
13	CL	B2(3)	88.6	11.53	20.53	.530	.176
14	CL	B2(4)	93.0	11.81	21.03	.519	.156
15	CL	B2(5)	98.3	12.14	21.62	.506	.133

C: normal cells or cells with medium straight section.

CL: cells with long straight section.

a_1, c_1 relative to beam emittance = 1.50π mm mrad.

a_2, c_2 relative to beam emittance = 4.75π mm mrad.

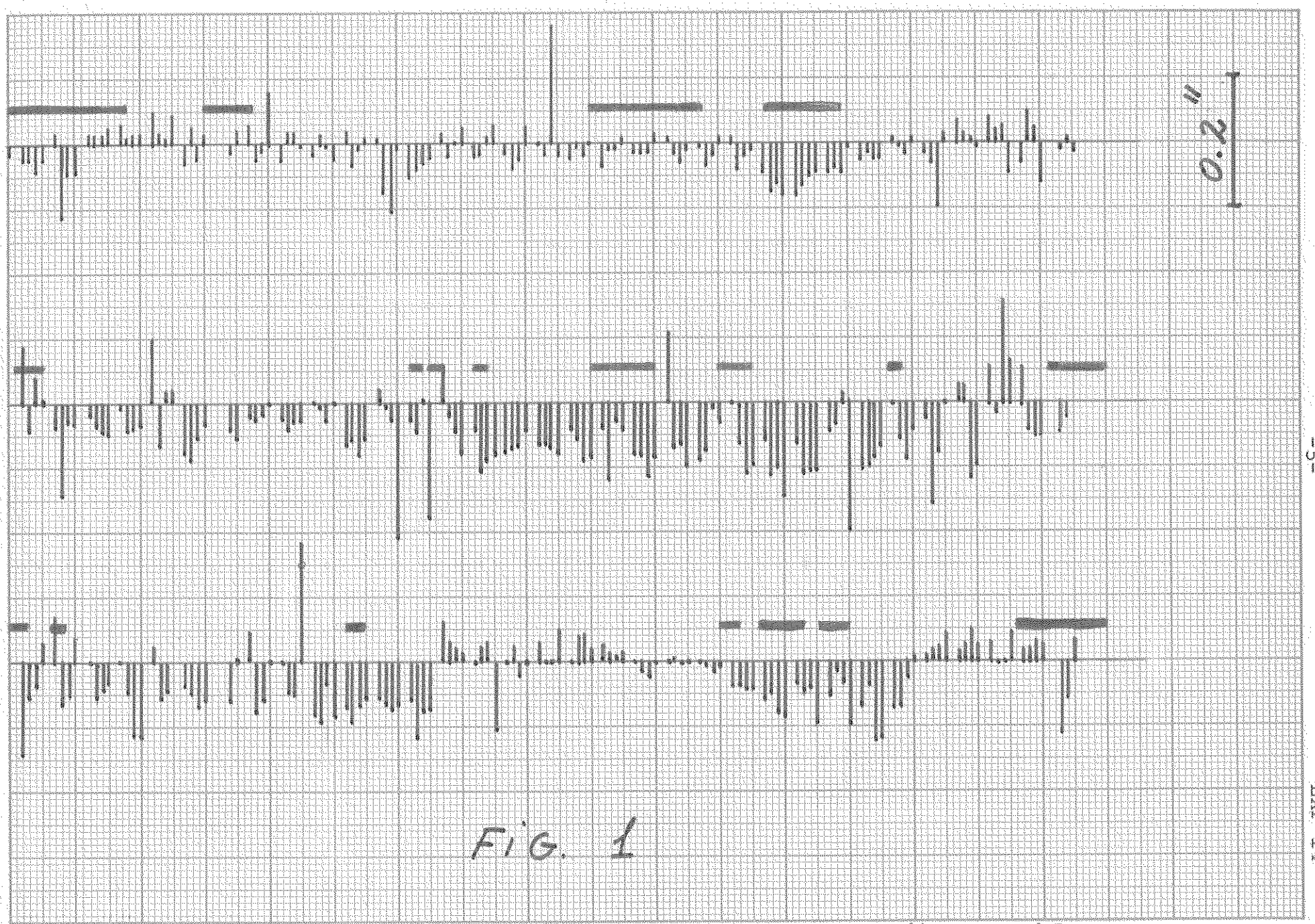

FIG. 1

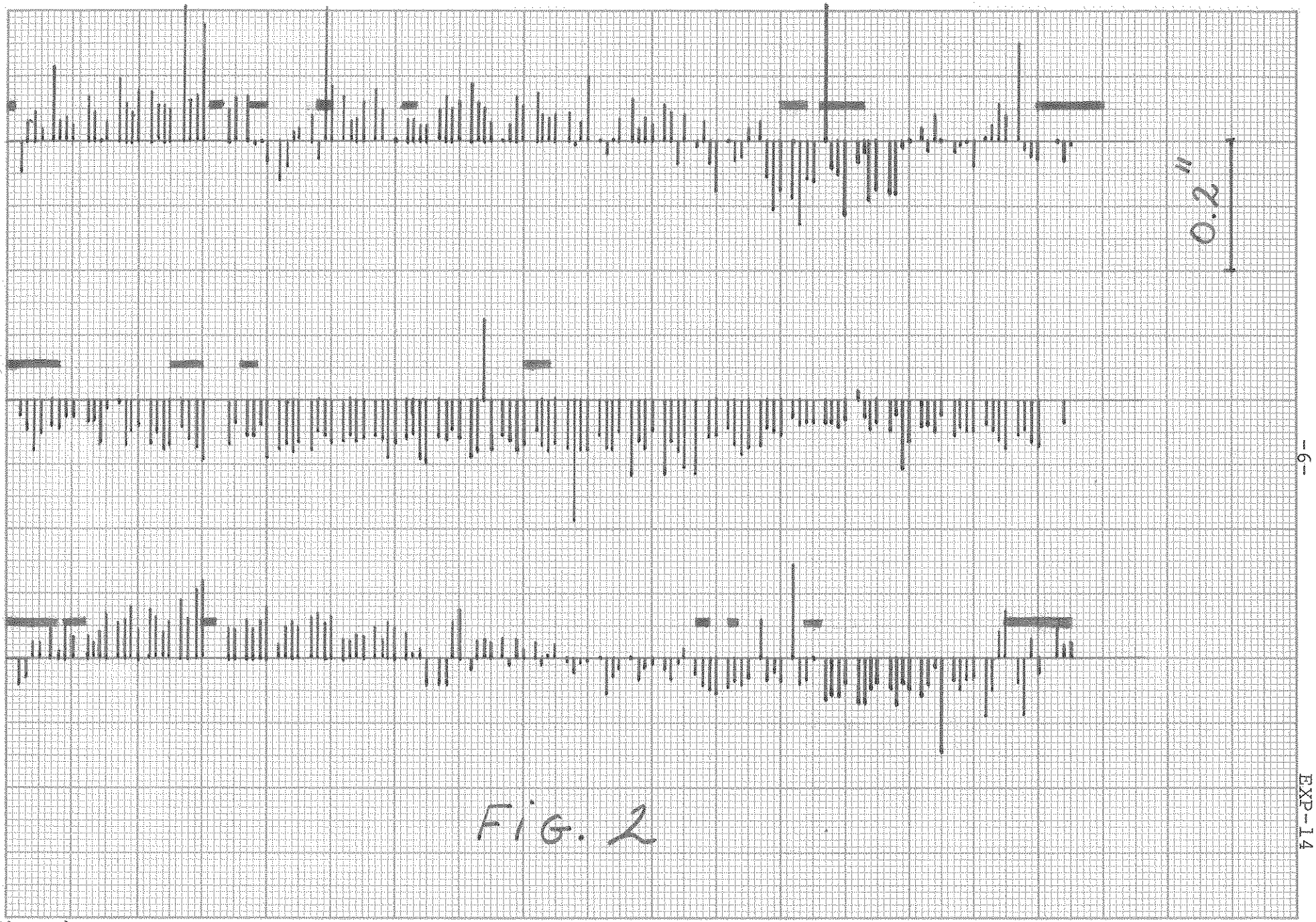

FIG. 2